



# IESNA LM-80-2008

MEASURING LUMEN MAINTENANCE OF LED LIGHT SOURCES

## MEASUREMENT AND TEST REPORT

For

**Guangzhou Hongli Opto-Electronic Co., Ltd.**

No.1, Xianke Yi Road, Huadong Town, Huadu District, Guangzhou, China

**Model: HL-A-2835DW-S1-08-HR3**

<b>Report Type:</b> 9000 Hours Test Report		<b>Product Type:</b> LED Package	
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<b>Report Number:</b>	RSZ140908501-10		
<b>Test Date:</b>	2014-09-12 to 2015-09-30		
<b>Report Date:</b>	2015-10-12		
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**Note:** The test data was only valid for the test sample(s). This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Dongguan).

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## TABLE OF CONTENTS

<b>1 - GENERAL INFORMATION.....</b>	<b>3</b>
1.1 DESCRIPTION OF LED LIGHT SOURCES .....	3
1.2 STANDARDS USED:.....	3
1.3 TEST FACILITY .....	3
1.4 DESCRIPTION OF AUXILIARY EQUIPMENT .....	3
1.5 OPERATING CYCLE.....	3
1.6 AMBIENT CONDITIONS .....	4
1.7 PHOTOMETRY MEASUREMENT UNCERTAINTY .....	4
1.8 SAMPLE SET .....	5
<b>2 - SUMMARY OF TEST RESULT .....</b>	<b>6</b>
<b>3 - TEST DATA .....</b>	<b>7</b>
3.1 DATA SET 1, 55°C, 150MA (LUMEN MAINTENANCE) .....	7
3.2 DATA SET 1, 55°C, 150MA (CHROMATICITY SHIFT) .....	8
3.3 DATA SET 2, 85°C, 150MA (LUMEN MAINTENANCE) .....	9
3.4 DATA SET 2, 85°C, 150MA (CHROMATICITY SHIFT) .....	10
3.5 DATA SET 3, 105°C, 150MA (LUMEN MAINTENANCE) .....	11
3.6 DATA SET 3, 105°C, 150MA (CHROMATICITY SHIFT) .....	12
<b>ATTACHMENT A – EUT PHOTO.....</b>	<b>13</b>
A.1 MECHANICAL DIMENSIONS (TA = 25°C).....	13
A.2 EUT PHOTO .....	13

## 1 - GENERAL INFORMATION

### 1.1 Description of LED Light Sources

Devices tested

Part Number: HL-A-2835DW-S1-08-HR3  
 Part Type: LED Package  
 Nominal CCT: 2700K

### 1.2 Standards Used:

- IESNA LM-80-08: IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- ENERGY STAR® Program Guidance Regarding LED Package, LED Array and LED Module Lumen Maintenance Performance Data Supporting Qualification of Lighting Products(This test method was not accredited by IAS)

### 1.3 Test Facility

The testing facility used by Bay Area Compliance Laboratories Corp. (Dongguan). is located at Pu Long Cun 69, Puxinghu Industrial Area, Tangxia Town, Dongguan, Guangdong, P.R.China.

### 1.4 Description of Auxiliary Equipment

Device	Manufacture	Model No	Serial No	Test Range	Calibration date	Calibration due date
Integral Sphere	EVERFINE	Diameter 0.3m	1011119	380-780nm, Diameter:0.3m,0-1999Lumen	2015-03-25	2016-03-25
Programmable Test Power for LEDs	EVERFINE	LED300E	1008002	15V/2000mA	2015-03-05	2016-03-05
High accuracy array spectroradiometer	EVERFINE	HAAS-2000	1012016T	380-780nm	2015-03-25	2016-03-25
Standard Light Source	EVERFINE	D062	1011093	N/A	2015-08-05	2016-08-05
Precision digital stabilized DC power supply	EVERFINE	WY605	G115987C J7321114	300VA	2015-03-05	2016-03-05
Multilayer aging machine	BACL	B2-270	20015	25°C~110°C	2015-03-05	2016-03-05
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11090007	(50V/15A)	2015-03-05	2016-03-05

### 1.5 Operating Cycle

Samples are driven with a constant direct current (DC)

## 1.6 Ambient Conditions

For lumen maintenance test, samples were operated in thermal chambers with minimal ambient airflow. For long term reliability test, the case temperature was controlled by mounting several thermocouples on a sample reliability stress board at the designated thermal measurement point, as shown in APPENDIX. The ambient temperature  $T_A$  was measured by several thermocouples at a distance of 5 mm above the reliability test board. The relative humidity within chamber was less than 65%.

For photometry measurement, temperature was set to  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , RH <65%.

## 1.7 Photometry Measurement Uncertainty

The uncertainty of the light output (luminous flux) measurements is  $U=1.59\%$  ( $K=2$ ), at the 95% confidence level. The uncertainty of the correlated color temperature measurements is  $U=21\text{K}$  ( $K=2$ ), at the 95% confidence level. The uncertainty of the CRI is  $U=1.7$  ( $K=2$ ), at the 95% confidence level. This calibration results traceable to the NATIONAL INSTITUTE OF METROLOGY (NIM).

## 1.8 Sample Set

### Sampling Method:

LED samples for IESNA LM-80 testing consist of units built from a minimum of three manufacturing lots with each manufacturing lot built from different wafer lots built on non-consecutive days.

These manufacturing lots are picked to represent a wide parametric distribution.

Each Sample is soldered to all of the reliability stress boards for a given set of IESNA LM-80 tests.

### Sample Size:

Total 75Pcs;

Each Ts test condition 25Pcs

The samples tested at Ts 55°C, Ts 85°C and Ts 105°C were received at 2014-09-08 and tested during 2014-09-12 to 2015-09-30. The samples were numbered from 1 to 25, 26 to 50 and 51 to 75

#### Data Set 1: 55°C, 150mA

Part Number:	HL-A-2835DW-S1-08-HR3
Number of Units:	25
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =54.1°C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =52.5°C
Life Test Drive Current:	I <sub>F</sub> = 150mA
Measurement Current:	I <sub>F</sub> = 150mA

#### Data Set 2: 85°C,150mA

Part Number:	HL-A-2835DW-S1-08-HR3
Number of Units:	25
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =84.3°C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =83.5°C
Life Test Drive Current:	I <sub>F</sub> =150mA
Measurement Current:	I <sub>F</sub> = 150mA

#### Data Set 3: 105°C, 150mA

Part Number:	HL-A-2835DW-S1-08-HR3
Number of Units:	25
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =104.4°C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =103.8°C
Life Test Drive Current:	I <sub>F</sub> = 150mA
Measurement Current:	I <sub>F</sub> = 150mA

## 2 - SUMMARY OF TEST RESULT

<b>Data Set:</b>	<b>Data Set 1, 55°C, 150mA</b>
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h,9000h
Average. Lumen Maintenance at 9000 hours:	97.02%
Average Chromaticity Shift at 9000 hours ( $\Delta u'v'$ ):	0.0025
Reported TM-21 L <sub>70</sub> Lifetime:	>54000 hours

<b>Data Set:</b>	<b>Data Set 2, 85°C, 150mA</b>
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h,9000h
Average. Lumen Maintenance at 9000 hours:	95.06%
Average Chromaticity Shift at 9000 hours( $\Delta u'v'$ ):	0.0023
Reported TM-21 L <sub>70</sub> Lifetime:	>54000 hours

<b>Data Set:</b>	<b>Data Set 3, 105°C, 150mA</b>
Number of Units:	25
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h,9000h
Average. Lumen Maintenance at 9000 hours:	93.35%
Average Chromaticity Shift at 9000 hours( $\Delta u'v'$ ):	0.0027
Reported TM-21 L <sub>70</sub> Lifetime:	41000 hours

### 3 - Test Data

#### 3.1 Data Set 1, 55°C, 150mA (Lumen Maintenance)

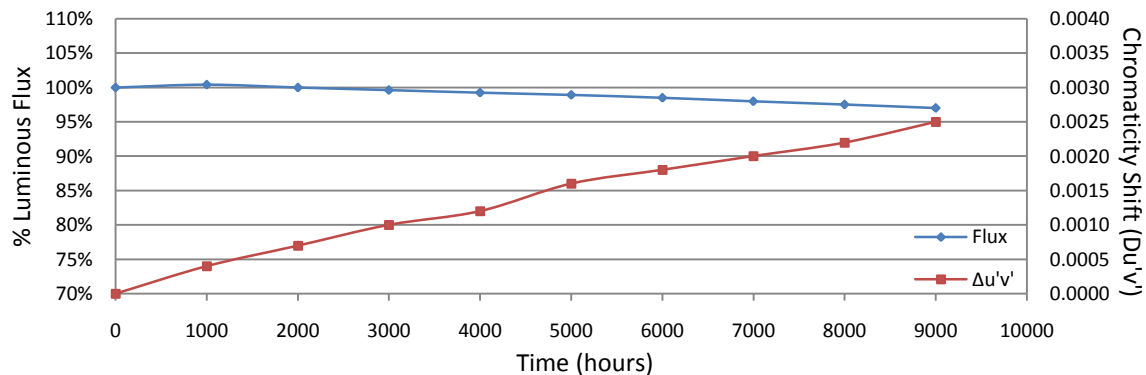
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)								
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
1	3.244	65.33	100.51	100.23	99.82	99.42	99.13	98.62	98.06	97.57	97.00
2	3.232	65.67	100.20	99.76	99.22	98.90	98.75	98.37	97.82	97.30	96.74
3	3.370	62.72	100.56	100.19	99.68	99.27	98.87	98.29	97.70	97.07	96.52
4	3.361	64.41	100.54	100.26	99.92	99.22	98.76	98.23	97.69	97.14	96.62
5	3.320	63.58	100.55	100.09	99.75	99.13	98.60	98.19	97.66	97.20	96.79
6	3.166	66.07	100.33	99.86	99.47	98.88	98.38	97.93	97.40	96.90	96.52
7	3.162	66.59	100.30	99.80	99.38	98.78	98.38	97.84	97.36	96.82	96.43
8	3.259	64.95	100.46	99.95	99.60	99.11	98.63	98.09	97.51	96.98	96.63
9	3.227	65.69	100.40	99.92	99.48	99.07	98.57	98.02	97.52	97.18	96.68
10	3.206	65.98	100.44	100.09	99.50	99.03	98.62	98.03	97.50	97.12	96.59
11	3.220	65.29	100.03	99.91	99.34	98.87	98.38	98.12	97.64	97.15	96.77
12	3.216	66.42	100.20	99.95	99.55	99.16	98.69	98.33	97.65	97.24	96.79
13	3.179	65.61	100.20	99.82	99.62	99.10	98.63	98.26	97.59	97.18	96.71
14	3.231	64.79	100.42	100.03	99.86	99.57	98.94	98.64	98.12	97.78	97.25
15	3.192	65.36	100.32	100.08	99.83	99.59	99.11	98.70	98.13	97.72	97.20
16	3.211	65.36	100.43	100.05	99.79	99.56	99.14	98.79	98.18	97.72	97.18
17	3.262	64.64	100.56	100.20	99.78	99.37	99.33	98.98	98.47	98.04	97.45
18	3.188	66.15	100.20	100.06	99.58	99.12	99.00	98.67	98.14	97.69	97.05
19	3.177	66.20	100.32	100.11	99.56	99.21	98.97	98.67	98.31	97.84	97.30
20	3.225	65.06	100.34	100.00	99.77	99.43	99.22	98.83	98.54	98.08	97.53
21	3.229	65.71	100.32	99.80	99.56	99.22	99.06	98.75	98.36	97.90	97.37
22	3.212	63.82	100.36	99.91	99.76	99.36	99.15	98.75	98.37	97.90	97.38
23	3.272	65.78	100.50	99.92	99.67	99.41	99.29	99.00	98.68	98.19	97.66
24	3.362	64.79	100.59	100.09	99.71	99.61	99.52	99.17	98.81	98.41	97.90
25	3.315	63.80	100.52	99.95	99.50	99.40	99.29	98.95	98.65	98.15	97.55
Ave.	3.242	65.19	100.38	100.00	99.63	99.23	98.90	98.49	97.99	97.53	97.02
Med.	3.227	65.36	100.40	100.00	99.62	99.22	98.94	98.62	98.06	97.57	97.00
st dev	0.061	0.96	0.1447	0.1403	0.1749	0.2374	0.3272	0.3774	0.4451	0.4588	0.4164
Min.	3.162	62.72	100.03	99.76	99.22	98.78	98.38	97.84	97.36	96.82	96.43
Max.	3.370	66.59	100.59	100.26	99.92	99.61	99.52	99.17	98.81	98.41	97.90

TM-21 Projection:

**Test Duration:** 9000 hours  
**Failures Observed:** 0  
 $\alpha$ : 4.559E-06  
 $\beta$ : 1.011  
**Calculated L<sub>70</sub>:** 81000 hours  
**Reported L<sub>70</sub>:** >54000 hours

### 3.2 Data Set 1, 55°C, 150mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
1	0.2610	0.5260	2737	0.0004	0.0008	0.0012	0.0013	0.0021	0.0023	0.0024	0.0022	0.0023
2	0.2612	0.5258	2733	0.0005	0.0008	0.0013	0.0014	0.0023	0.0024	0.0024	0.0025	0.0024
3	0.2611	0.5260	2734	0.0003	0.0006	0.0010	0.0012	0.0017	0.0021	0.0022	0.0022	0.0022
4	0.2606	0.5259	2747	0.0004	0.0007	0.0011	0.0012	0.0018	0.0023	0.0024	0.0026	0.0026
5	0.2618	0.5255	2723	0.0004	0.0007	0.0011	0.0012	0.0014	0.0018	0.0019	0.0022	0.0027
6	0.2624	0.5263	2706	0.0003	0.0007	0.0011	0.0012	0.0016	0.0017	0.0021	0.0024	0.0027
7	0.2626	0.5259	2704	0.0004	0.0008	0.0011	0.0014	0.0017	0.0018	0.0020	0.0024	0.0029
8	0.2612	0.5275	2726	0.0003	0.0006	0.0009	0.0011	0.0013	0.0015	0.0017	0.0021	0.0025
9	0.2616	0.5234	2736	0.0004	0.0008	0.0011	0.0014	0.0016	0.0017	0.0020	0.0023	0.0028
10	0.2649	0.5273	2651	0.0004	0.0007	0.0009	0.0012	0.0016	0.0017	0.0019	0.0022	0.0027
11	0.2622	0.5267	2710	0.0005	0.0008	0.0011	0.0014	0.0017	0.0019	0.0019	0.0022	0.0027
12	0.2611	0.5259	2735	0.0005	0.0009	0.0010	0.0013	0.0016	0.0018	0.0019	0.0021	0.0026
13	0.2617	0.5245	2729	0.0005	0.0008	0.0009	0.0013	0.0017	0.0019	0.0019	0.0021	0.0027
14	0.2614	0.5263	2726	0.0004	0.0007	0.0008	0.0011	0.0014	0.0016	0.0019	0.0020	0.0024
15	0.2614	0.5270	2724	0.0004	0.0007	0.0008	0.0011	0.0013	0.0016	0.0019	0.0020	0.0025
16	0.2615	0.5261	2727	0.0004	0.0009	0.0010	0.0012	0.0015	0.0018	0.0019	0.0021	0.0026
17	0.2619	0.5252	2722	0.0004	0.0008	0.0009	0.0011	0.0014	0.0017	0.0019	0.0021	0.0025
18	0.2617	0.5266	2721	0.0006	0.0008	0.0010	0.0012	0.0015	0.0018	0.0020	0.0022	0.0027
19	0.2634	0.5271	2682	0.0004	0.0007	0.0009	0.0011	0.0014	0.0017	0.0019	0.0020	0.0023
20	0.2655	0.5281	2635	0.0004	0.0008	0.0011	0.0013	0.0016	0.0019	0.0019	0.0022	0.0024
21	0.2614	0.5252	2731	0.0004	0.0005	0.0009	0.0011	0.0013	0.0017	0.0017	0.0020	0.0022
22	0.2619	0.5244	2725	0.0004	0.0006	0.0010	0.0012	0.0015	0.0018	0.0019	0.0021	0.0024
23	0.2619	0.5261	2719	0.0004	0.0005	0.0009	0.0011	0.0014	0.0017	0.0017	0.0020	0.0022
24	0.2624	0.5260	2707	0.0004	0.0004	0.0009	0.0011	0.0013	0.0015	0.0016	0.0019	0.0021
25	0.2615	0.5259	2726	0.0004	0.0004	0.0009	0.0011	0.0014	0.0016	0.0017	0.0020	0.0022
Ave.	0.2620	0.5260	2717	0.0004	0.0007	0.0010	0.0012	0.0016	0.0018	0.0020	0.0022	0.0025
Med.	0.2617	0.5260	2725	0.0004	0.0007	0.0010	0.0012	0.0015	0.0018	0.0019	0.0021	0.0025
st dev	0.0011	0.0010	26	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002
Min.	0.2606	0.5234	2635	0.0003	0.0004	0.0008	0.0011	0.0013	0.0015	0.0016	0.0019	0.0021
Max.	0.2655	0.5281	2747	0.0006	0.0009	0.0013	0.0014	0.0023	0.0024	0.0024	0.0026	0.0029





**3.3 Data Set 2, 85°C, 150mA (Lumen Maintenance)**

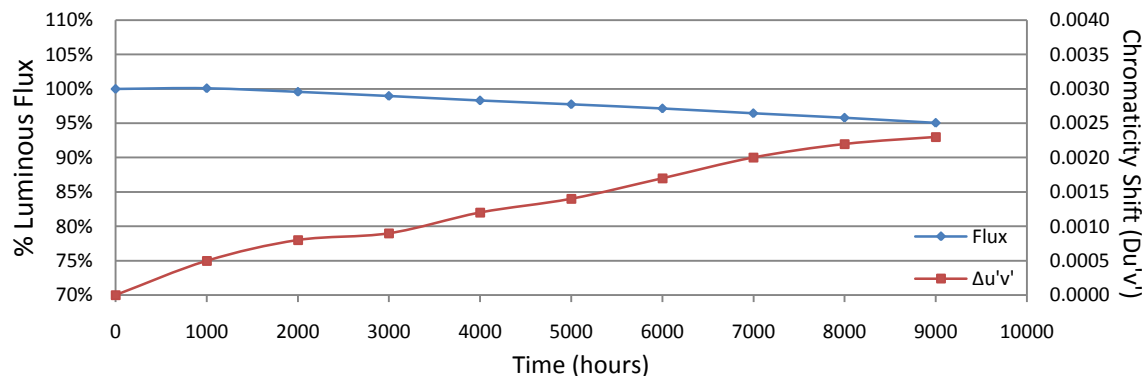
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)								
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
26	3.164	66.01	100.23	99.68	99.21	98.61	98.02	97.45	96.71	96.09	95.27
27	3.211	64.19	100.31	99.92	99.38	98.82	98.24	97.60	96.90	96.21	95.51
28	3.277	66.49	100.29	99.77	99.26	98.66	98.45	97.91	97.34	96.54	95.83
29	3.216	66.18	100.17	99.65	99.12	98.53	97.98	97.34	96.60	96.52	95.65
30	3.270	66.24	100.03	99.46	98.94	98.35	97.87	97.15	96.45	96.00	95.37
31	3.235	66.25	100.09	99.55	99.00	98.40	97.87	97.16	96.48	95.73	95.58
32	3.250	64.60	100.14	99.67	99.16	98.54	97.96	97.15	96.49	95.91	95.20
33	3.200	65.32	100.14	99.80	99.20	98.55	98.06	97.34	96.62	95.87	95.18
34	3.304	63.49	100.19	99.81	99.17	98.58	98.14	97.40	96.69	96.00	95.32
35	3.212	65.48	100.18	99.66	99.08	98.52	98.09	97.27	96.66	95.85	95.17
36	3.281	65.60	100.11	99.65	99.10	98.48	97.80	97.32	96.55	95.90	95.23
37	3.210	64.45	100.29	99.72	99.10	98.51	97.78	97.27	96.52	95.84	95.07
38	3.187	66.27	99.89	99.25	98.67	97.95	97.37	96.86	96.11	95.47	94.66
39	3.440	65.62	100.49	99.80	99.33	98.66	98.03	97.52	96.80	96.19	95.35
40	3.219	65.14	99.98	99.60	98.83	98.23	97.62	97.04	96.35	95.72	94.89
41	3.244	65.19	100.11	99.66	98.94	98.40	97.67	97.13	96.41	95.74	94.94
42	3.229	63.97	100.00	99.50	98.84	98.26	97.48	96.76	96.03	95.34	94.75
43	3.278	64.69	99.98	99.47	98.79	97.99	97.48	96.99	96.24	95.58	94.79
44	3.204	66.84	100.00	99.36	98.67	98.00	97.38	96.89	96.15	95.48	94.63
45	3.365	63.93	100.19	99.64	98.97	98.34	97.70	97.00	96.45	95.82	95.06
46	3.178	65.70	99.92	99.42	98.69	98.04	97.38	96.86	96.10	95.54	94.63
47	3.213	65.39	99.89	99.27	98.65	97.97	97.35	96.80	96.07	95.34	94.74
48	3.305	66.60	99.94	99.32	98.71	98.02	97.40	96.89	96.16	95.33	94.73
49	3.207	67.24	100.06	99.41	98.77	98.05	97.44	96.92	96.22	95.40	94.74
50	3.224	64.96	99.68	98.86	98.20	97.52	96.94	96.37	95.69	94.83	94.20
Ave.	3.245	65.43	100.09	99.56	98.95	98.32	97.74	97.14	96.43	95.77	95.06
Med.	3.224	65.48	100.11	99.64	98.97	98.40	97.78	97.15	96.45	95.82	95.07
st dev	0.061	0.98	0.1691	0.2320	0.2710	0.3069	0.3527	0.3221	0.3392	0.3905	0.3872
Min.	3.164	63.49	99.68	98.86	98.20	97.52	96.94	96.37	95.69	94.83	94.20
Max.	3.440	67.24	100.49	99.92	99.38	98.82	98.45	97.91	97.34	96.54	95.83

## TM-21 Projection:

**Test Duration:** 9000 hours  
**Failures Observed:** 0  
**α:** 6.772E-06  
**β:** 1.011  
**Calculated L<sub>70</sub>:** 54000 hours  
**Reported L<sub>70</sub>:** >54000 hours

### 3.4 Data Set 2, 85°C, 150mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
26	0.2618	0.5243	2727	0.0005	0.0006	0.0009	0.0013	0.0015	0.0018	0.0021	0.0021	0.0024
27	0.2634	0.5261	2686	0.0005	0.0006	0.0009	0.0012	0.0014	0.0018	0.0020	0.0021	0.0024
28	0.2613	0.5259	2731	0.0005	0.0007	0.0008	0.0011	0.0014	0.0016	0.0019	0.0019	0.0021
29	0.2614	0.5245	2736	0.0005	0.0008	0.0009	0.0012	0.0014	0.0017	0.0020	0.0021	0.0023
30	0.2615	0.5264	2725	0.0005	0.0008	0.0009	0.0013	0.0015	0.0017	0.0020	0.0021	0.0024
31	0.2613	0.5259	2731	0.0005	0.0007	0.0009	0.0011	0.0014	0.0017	0.0020	0.0021	0.0023
32	0.2635	0.5277	2679	0.0005	0.0009	0.0010	0.0012	0.0015	0.0018	0.0021	0.0022	0.0024
33	0.2621	0.5250	2717	0.0004	0.0006	0.0008	0.0011	0.0013	0.0016	0.0019	0.0021	0.0022
34	0.2612	0.5255	2735	0.0004	0.0006	0.0008	0.0011	0.0013	0.0016	0.0018	0.0021	0.0022
35	0.2624	0.5263	2707	0.0004	0.0008	0.0009	0.0012	0.0014	0.0018	0.0020	0.0022	0.0023
36	0.2608	0.5257	2743	0.0003	0.0007	0.0008	0.0011	0.0014	0.0017	0.0020	0.0021	0.0023
37	0.2615	0.5252	2731	0.0005	0.0008	0.0010	0.0012	0.0014	0.0017	0.0020	0.0021	0.0023
38	0.2622	0.5263	2710	0.0003	0.0009	0.0009	0.0012	0.0014	0.0018	0.0021	0.0022	0.0023
39	0.2618	0.5242	2727	0.0004	0.0006	0.0008	0.0011	0.0013	0.0016	0.0019	0.0021	0.0022
40	0.2619	0.5263	2717	0.0004	0.0006	0.0008	0.0011	0.0013	0.0016	0.0019	0.0021	0.0022
41	0.2614	0.5240	2736	0.0004	0.0007	0.0008	0.0011	0.0014	0.0017	0.0020	0.0021	0.0023
42	0.2627	0.5260	2702	0.0004	0.0008	0.0009	0.0013	0.0015	0.0018	0.0021	0.0023	0.0023
43	0.2627	0.5264	2700	0.0004	0.0008	0.0008	0.0012	0.0014	0.0017	0.0020	0.0021	0.0023
44	0.2627	0.5270	2697	0.0004	0.0008	0.0009	0.0012	0.0015	0.0018	0.0021	0.0023	0.0024
45	0.2614	0.5241	2736	0.0004	0.0007	0.0008	0.0011	0.0013	0.0016	0.0019	0.0021	0.0023
46	0.2619	0.5271	2713	0.0005	0.0007	0.0009	0.0013	0.0015	0.0017	0.0021	0.0022	0.0023
47	0.2634	0.5273	2682	0.0005	0.0009	0.0009	0.0013	0.0015	0.0017	0.0021	0.0023	0.0024
48	0.2621	0.5265	2712	0.0004	0.0007	0.0008	0.0011	0.0014	0.0017	0.0020	0.0021	0.0023
49	0.2613	0.5268	2728	0.0004	0.0008	0.0009	0.0012	0.0014	0.0017	0.0020	0.0021	0.0023
50	0.2610	0.5236	2747	0.0008	0.0014	0.0016	0.0019	0.0021	0.0023	0.0027	0.0029	0.0030
Ave.	0.2619	0.5258	2718	0.0005	0.0008	0.0009	0.0012	0.0014	0.0017	0.0020	0.0022	0.0023
Med.	0.2618	0.5260	2725	0.0004	0.0007	0.0009	0.0012	0.0014	0.0017	0.0020	0.0021	0.0023
st dev	0.0008	0.0011	19	0.0001	0.0002	0.0002	0.0002	0.0002	0.0001	0.0002	0.0002	0.0002
Min.	0.2608	0.5236	2679	0.0003	0.0006	0.0008	0.0011	0.0013	0.0016	0.0018	0.0019	0.0021
Max.	0.2635	0.5277	2747	0.0008	0.0014	0.0016	0.0019	0.0021	0.0023	0.0027	0.0029	0.0030



**3.5 Data Set 3, 105°C, 150mA (Lumen Maintenance)**

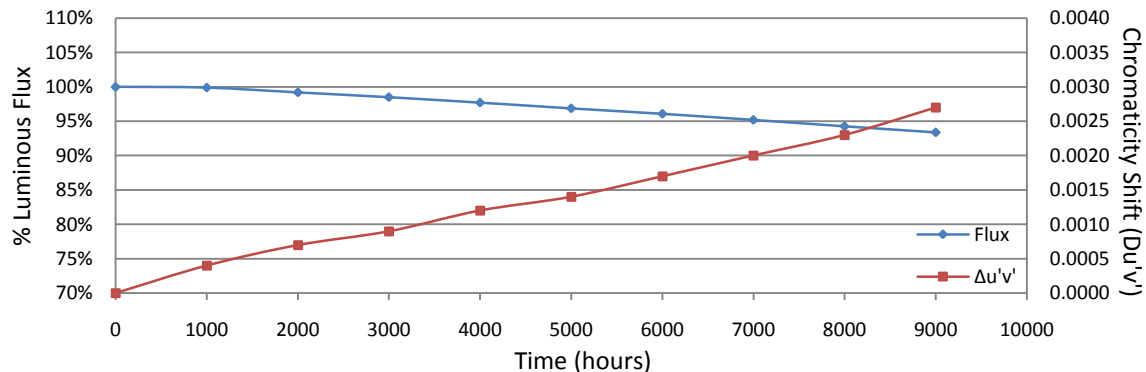
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)								
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
51	3.194	65.68	99.89	99.51	98.78	97.98	97.15	96.38	95.39	94.37	93.47
52	3.212	66.59	99.80	99.10	98.56	97.76	96.83	96.05	95.10	94.04	93.12
53	3.239	65.00	99.91	99.48	98.97	98.26	97.22	96.54	95.58	94.57	93.65
54	3.206	64.89	100.03	99.45	98.78	98.26	97.26	96.53	95.58	94.59	93.67
55	3.186	65.95	99.76	99.01	98.54	97.95	97.00	96.25	95.31	94.30	93.40
56	3.177	64.93	99.95	99.20	98.75	98.12	97.17	96.35	95.47	94.49	93.49
57	3.251	64.82	99.98	99.32	98.49	98.26	97.41	96.53	95.70	94.63	93.77
58	3.191	66.20	99.77	99.06	98.29	97.82	97.15	96.27	95.42	94.61	93.53
59	3.271	65.75	100.24	99.41	98.63	98.16	97.49	96.70	95.85	95.00	94.11
60	3.265	67.22	99.67	98.96	98.23	97.68	97.01	96.16	95.34	94.48	93.59
61	3.165	65.34	99.71	99.16	98.39	97.44	96.56	96.07	95.49	94.64	93.73
62	3.177	66.46	99.73	98.99	98.25	97.35	96.46	96.00	95.34	94.51	93.62
63	3.317	64.32	99.94	99.21	98.54	97.56	96.67	96.02	95.20	94.78	93.89
64	3.235	65.41	100.02	99.13	98.38	97.43	96.51	95.70	94.89	94.30	93.58
65	3.166	66.18	99.83	99.00	98.25	97.34	96.40	95.59	94.56	93.74	92.85
66	3.182	65.54	99.86	99.08	98.38	97.42	96.44	95.61	94.72	93.81	92.94
67	3.215	66.18	99.82	99.08	98.37	97.43	96.48	95.71	94.83	93.87	92.97
68	3.218	65.06	99.85	99.17	98.51	97.40	96.48	95.68	94.90	93.88	92.96
69	3.225	65.71	99.82	99.07	98.37	97.46	96.51	95.75	94.90	93.93	92.98
70	3.257	64.93	99.98	99.28	98.55	97.72	96.84	95.98	95.15	94.16	93.25
71	3.245	65.46	99.97	99.22	98.38	97.53	96.93	95.83	94.91	93.97	93.03
72	3.174	66.22	99.85	98.97	98.23	97.36	96.66	95.56	94.68	93.85	92.84
73	3.255	64.88	99.92	99.15	98.40	97.53	97.03	96.18	95.10	94.17	93.08
74	3.271	62.75	99.97	99.20	98.47	97.59	97.04	96.24	95.36	94.23	93.26
75	3.194	66.48	99.79	98.95	98.15	97.32	96.69	95.89	94.98	93.91	92.84
Ave.	3.220	65.52	99.88	99.17	98.47	97.69	96.86	96.06	95.19	94.27	93.35
Med.	3.215	65.54	99.86	99.15	98.40	97.56	96.84	96.05	95.20	94.30	93.40
st dev	0.040	0.90	0.1241	0.1638	0.2016	0.3237	0.3296	0.3331	0.3379	0.3485	0.3672
Min.	3.165	62.75	99.67	98.95	98.15	97.32	96.40	95.56	94.56	93.74	92.84
Max.	3.317	67.22	100.24	99.51	98.97	98.26	97.49	96.70	95.85	95.00	94.11

## TM-21 Projection:

**Test Duration:** 9000 hours  
**Failures Observed:** 0  
**α:** 9.075E-06  
**β:** 1.014  
**Calculated L<sub>70</sub>:** 41000 hours  
**Reported L<sub>70</sub>:** 41000 hours

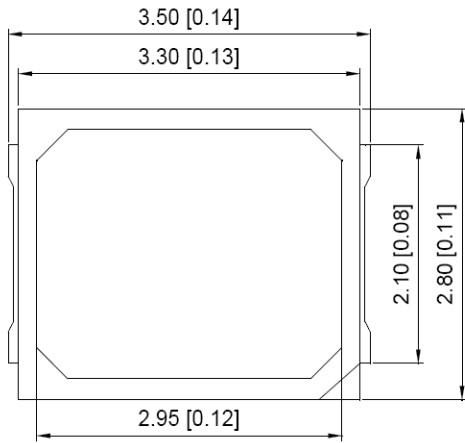
### 3.6 Data Set 3, 105°C, 150mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )								
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs
51	0.2612	0.5240	2742	0.0005	0.0008	0.0009	0.0012	0.0014	0.0017	0.0021	0.0023	0.0027
52	0.2629	0.5260	2697	0.0004	0.0008	0.0008	0.0011	0.0012	0.0017	0.0020	0.0023	0.0025
53	0.2629	0.5270	2693	0.0003	0.0008	0.0009	0.0012	0.0014	0.0017	0.0021	0.0023	0.0026
54	0.2618	0.5262	2718	0.0003	0.0007	0.0009	0.0011	0.0014	0.0017	0.0020	0.0023	0.0026
55	0.2621	0.5249	2718	0.0004	0.0008	0.0010	0.0013	0.0014	0.0019	0.0021	0.0025	0.0028
56	0.2613	0.5254	2734	0.0004	0.0008	0.0009	0.0012	0.0014	0.0017	0.0021	0.0024	0.0027
57	0.2625	0.5262	2705	0.0003	0.0008	0.0009	0.0012	0.0014	0.0017	0.0020	0.0023	0.0026
58	0.2624	0.5255	2709	0.0004	0.0007	0.0009	0.0012	0.0014	0.0017	0.0021	0.0023	0.0028
59	0.2618	0.5255	2722	0.0002	0.0006	0.0009	0.0011	0.0013	0.0017	0.0019	0.0022	0.0026
60	0.2643	0.5269	2665	0.0001	0.0007	0.0009	0.0012	0.0014	0.0017	0.0020	0.0023	0.0027
61	0.2628	0.5258	2700	0.0002	0.0007	0.0008	0.0011	0.0014	0.0017	0.0020	0.0023	0.0026
62	0.2627	0.5267	2698	0.0004	0.0006	0.0008	0.0012	0.0014	0.0017	0.0020	0.0023	0.0026
63	0.2617	0.5267	2719	0.0003	0.0006	0.0008	0.0011	0.0013	0.0017	0.0020	0.0022	0.0026
64	0.2613	0.5239	2740	0.0004	0.0006	0.0008	0.0011	0.0014	0.0016	0.0020	0.0023	0.0028
65	0.2617	0.5243	2729	0.0004	0.0007	0.0009	0.0012	0.0014	0.0017	0.0020	0.0023	0.0026
66	0.2622	0.5257	2713	0.0004	0.0006	0.0009	0.0012	0.0013	0.0017	0.0019	0.0023	0.0027
67	0.2612	0.5262	2731	0.0003	0.0005	0.0007	0.0011	0.0012	0.0016	0.0019	0.0022	0.0026
68	0.2617	0.5248	2728	0.0004	0.0007	0.0009	0.0012	0.0014	0.0017	0.0020	0.0023	0.0028
69	0.2623	0.5254	2711	0.0003	0.0005	0.0008	0.0011	0.0013	0.0016	0.0019	0.0022	0.0026
70	0.2614	0.5254	2731	0.0004	0.0006	0.0008	0.0011	0.0014	0.0016	0.0019	0.0022	0.0026
71	0.2618	0.5265	2718	0.0005	0.0008	0.0009	0.0013	0.0014	0.0018	0.0020	0.0024	0.0027
72	0.2623	0.5264	2707	0.0004	0.0006	0.0009	0.0012	0.0014	0.0017	0.0020	0.0022	0.0026
73	0.2619	0.5244	2724	0.0004	0.0007	0.0008	0.0011	0.0013	0.0016	0.0019	0.0023	0.0026
74	0.2624	0.5258	2709	0.0003	0.0006	0.0007	0.0011	0.0013	0.0016	0.0019	0.0021	0.0026
75	0.2613	0.5251	2735	0.0005	0.0008	0.0009	0.0013	0.0014	0.0017	0.0020	0.0024	0.0027
Ave.	0.2621	0.5256	2716	0.0004	0.0007	0.0009	0.0012	0.0014	0.0017	0.0020	0.0023	0.0027
Med.	0.2619	0.5257	2718	0.0004	0.0007	0.0009	0.0012	0.0014	0.0017	0.0020	0.0023	0.0026
st dev	0.0007	0.0009	17	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Min.	0.2612	0.5239	2665	0.0001	0.0005	0.0007	0.0011	0.0012	0.0016	0.0019	0.0021	0.0025
Max.	0.2643	0.5270	2742	0.0005	0.0008	0.0010	0.0013	0.0014	0.0019	0.0021	0.0025	0.0028



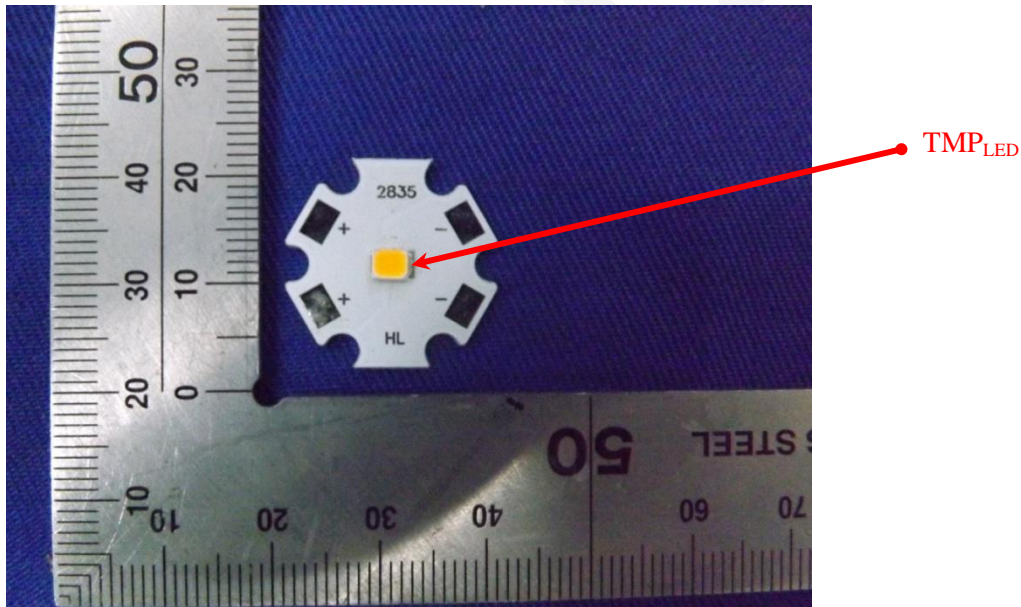
## Attachment A – EUT PHOTO

### A.1 Mechanical Dimensions (Ta = 25°C)



All dimensions are in millimeter

### A.2 EUT Photo



\*\*\*\*\*END OF REPORT\*\*\*\*\*